Medical Applications

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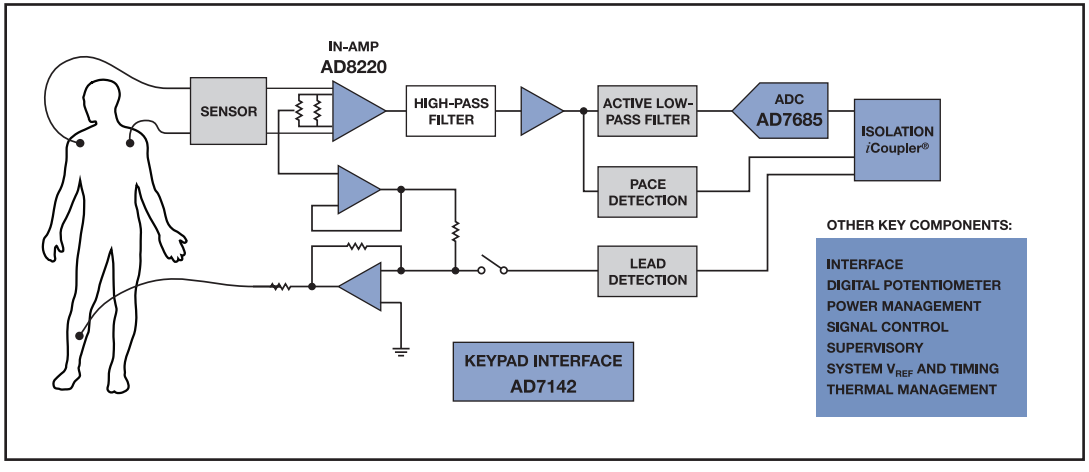
www.analog.com/everywhere

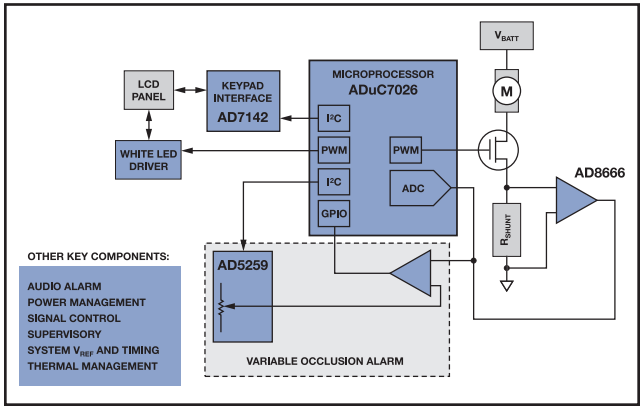
ANALOG DEVICES

Signal Chains

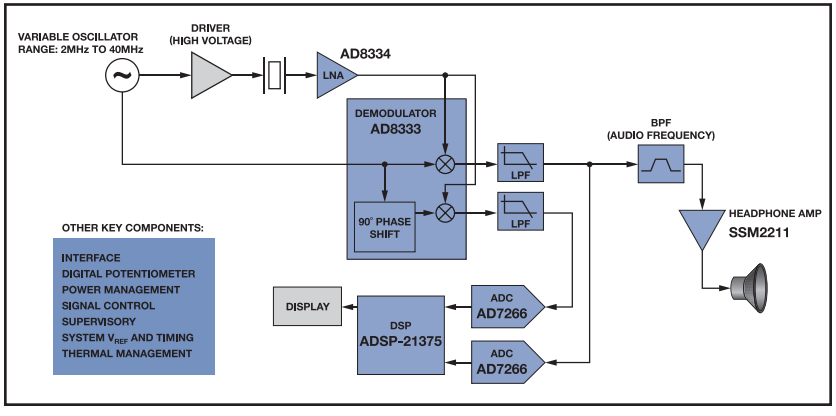
EKG (AD8220, AD7685, AD7142)



IV Pump (ADuC7026, AD8666, AD7142, AD5259)



Doppler Blood Flow Monitor (AD8334, AD8333, AD7266, SSM2211, ADSP-21375)



Digital Potentiometers

AD5259 Single 8-Bit Nonvolatile I²C Digital Potentiometer

Key Features

- Single-channel
- 256-position resolution
- Small packages
- 5 kΩ, 10 kΩ, 50 kΩ, 100 kΩ resistor values
- Nonvolatile memory

Benefits

- Low price, nonvolatile and compact MSOP-10 package
- Separate bias supply from logic supply allows wider terminal voltage operation

Key Applications

- LCD panel VCOM adjustment
- LCD panel brightness and contrast control
- Programmable power supplies
- RF amplifier biasing

Cost

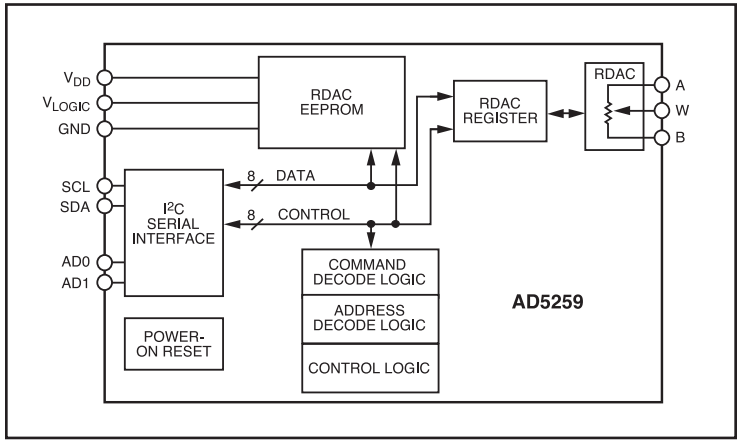
$0.89 per unit in 1k quantity

Package Options

- Thin LFCSP-10 (3 mm x 3 mm x 0.8 mm)
- Compact MSOP-10 (3 mm x 4.9 mm x 1.1mm)

Product Link

www.analog.com/AD5259



Converters: ADCs

AD7266 Differential Input, Dual 2 MSPS, 12-Bit, 3-Channel SAR ADC

Key Features

- Dual 12-bit, 3-channel ADC
- Throughput rate: 2 MSPS per ADC
- 1 MSPS version available: AD7265
- Specified for VDD of 2.7 V to 5.25 V
- Power consumption
  - - 9 mW at 1.5 MSPS with 3 V supplies
  - - 27 mW at 2 MSPS with 5 V supplies
- Pin-configurable analog inputs
  - 12-channel single-ended inputs
  - 6-channel fully differential inputs
  - 6-channel pseudo-differential inputs
- 70 dB SNR at 50 kHz input frequency
- On-chip reference 2.5 V, 20 ppm/°C max
- -40°C to +125°C operation
- Flexible power/throughput rate management
- Dual conversion with read 437.5 ns, 32 MHz SCLK

Benefits

- High throughput
  - 2 MSPS simultaneous sampling
  - Configurable input ranges
- 3 differential channels before each ADC
  - configurable as 6 single-ended (x2)
- On-chip reference
  - 2.5 V 10 ppm
- Low power operation
  - 27 mW max @ 2 MSPS @ 5 V
- Specified for automotive temp. ranges
  - -40°C to +125°C

Key Applications

- Motor control: encoder feedback or current sense.
- Motion control: robotics
- Sonar
- Radio frequency identification

Cost

$7.55 per unit in 1k quantity

Package Options

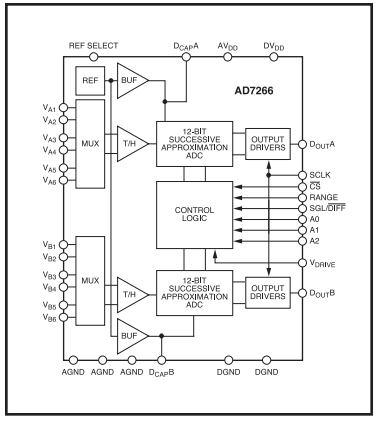
- 32-lead LFCSP

Suggested Complementary Parts

ADA4851-4: low cost, high speed, rail-to-rail output operational amplifier
AD8040: low-power, high-speed, rail-to-rail input/output operational amplifier
AD1582: 2.5 V micropower, precision series mode voltage reference
AD5444: 12-bit high bandwidth multiplying DACs with serial interface

Product Link

www.analog.com/AD7266

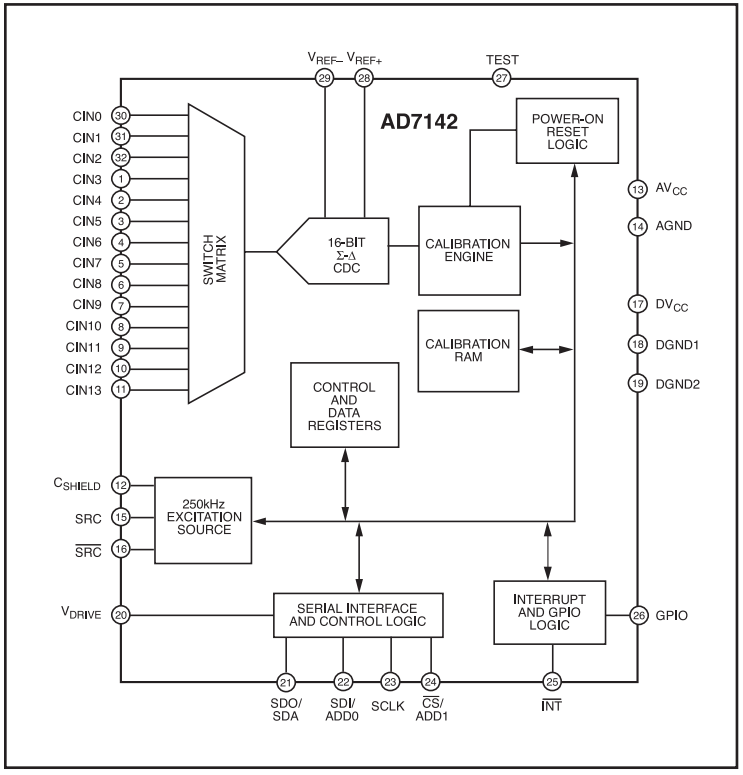


Converters: Capacitance-to-Digital

AD7142 Programmable Capacitance-to-Digital Converter with Environmental Compensation

Key Features

- Dedicated programmable solution
- High resolution 16-bit accuracy
- On-chip environmental and sensitivity compensation
- Single power supply
- Low operating current:
  full power mode: less than 1 mA
  low power mode: 50 µA



Benefits

- Enables rapid prototyping and development
- Requires no external RC components
- SPI®- or I²C®- (AD7142-1) compatible serial interface
- Extremely easy to implement allowing the interface designers to spend more time on user interface designs

Key Applications

- Replacement of traditional mechanical buttons, scroll wheels and sliders
- MP3, PMP and PVP players
- Cell phone touch control
- Automobile console
- Industrial appliances
- Medical devices

Cost

$1.35 per unit in 1k quantity

Packsge Options

- 32-lead 5x5mm LFCSP

Product Link

http://www.analog.com/AD7142

Converters: ADCs

AD7685 16-Bit 250 kSPS PulSAR® ADC

Key Features

- 16-bit resolution no missing codes
- Throughput: 250 kSPS
- INL: ±0.6 LSB typ, ±2 LSB max
- SINAD: 93.5 dB @ 20 kHz
- THD: -110 dB @ 20 kHz

Benefits

- Smallest package
- Low power that scales with throughput rate
- Best performance in class (93.5 dB SINAD)
- Competitive pricing

Key Applications

- ATE
- Battery operated and isolated equipment
- Medical instruments
- Process control

Cost (per unit in 1k quantity)

AD7685A (6 LSB INL)	$6.50
AD7685B (3 LSB INL)	$8.00
AD7685C (2 LSB INL)	$9.60

Package Options

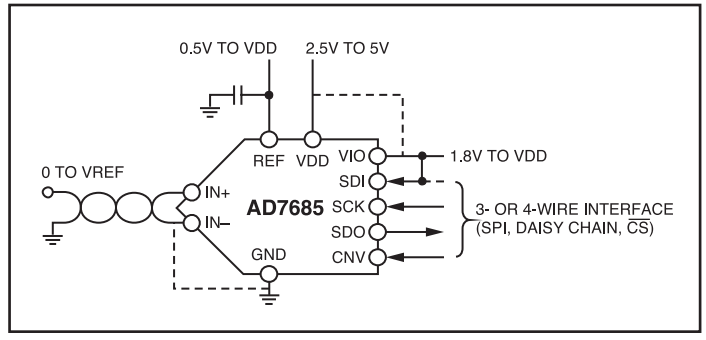
- 10-lead MSOP
- 10-lead LFCSP (QFN)

Related Devices

Model	Resolution (bits)	Sampling Rate (kSPS)	Voltage Supply (V)
AD7686	16	500	5
AD7690	18	400	5
AD7691	18	250	2.3 to 5
AD7693	16	500	5

Product Link

www.analog.com/AD7685



Microcontrollers: Precision Analog Microcontroller

ADuC702x Series: ARM7 Microcontrollers with Flash and Precision Data Converters

Key Features

- Multi-channel 1MSPS 12-bit ADC
- 45 MHz ARM7 with up to 126 kbytes flash
- Small package options
- Programmable logic array
- Multiple 12-bit DACs, voltage reference, temp sensor
- Full suite of development tools at low cost

Benefits

- Integration of analog and digital eases board-level design
- On-chip precision analog peripherals reduces BOM
- Flexible clocking of the core facilitating lower power
- On-chip oscillator reduces component count and cost
- On-chip PLA eliminates external glue logic
- Suite of easy-to-use, low-cost development tools simplify code development

Key Applications

- Precision sensor interfacing
- Medical instrumentation
- Blood oximetry
- Patient monitors
- ECG

Cost

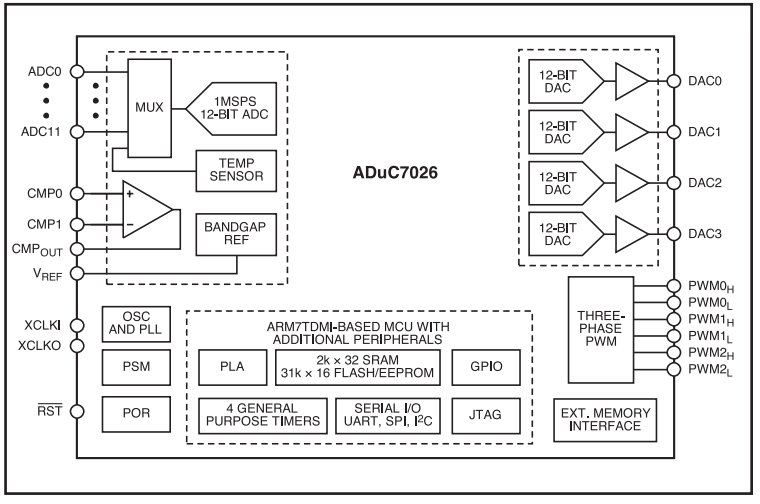
$3.98 per unit in 1k quantity

Package Options

- 40-lead 6mm x6 mm LFCSP
- 64-lead LFCSP and LQFP
- 80-lead LQFP
- 64-ball 6 mm x6 mm BGA

Product Link

www.analog.com/microconverter



Amplifiers: Precision Operational Amplifiers

AD8666 16 V, 4 MHz Rail-to-Rail Output Dual Amplifier

Key Features

- Offset voltage: 2.5 mV max.
- Low input bias current: 1 pA max.
- Single-supply operation: 5 V to 16 V
- Dual-supply operation: ±2.5 V to ±8 V
- Low noise: 8 nV/√Hz @ 10 kHz
- Wide bandwidth: 4 MHz
- Rail-to-rail output

Benefits

- General purpose 16 V or ±8 V amplifier—great for building multi-purpose circuits
- Low bias current
- Rail-to-rail outputs for increase dynamic range—ideal as low cost ADC drivers

Key Applications

- Sensor amplification
- Reference buffering
- Medical equipment
- Physiological measurements
- Filters
- Photodiode pre-amps
- ADC drivers
- Level shifting/DC bias

Cost

$0.78 per unit in 1k quantity

Package Options

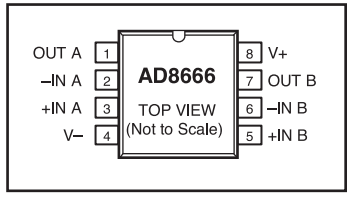
- 8-lead MSOP
- 8-lead SOIC

Related Devices

Part Number	V_{SY}	V_{OS} max	I_{SY} max	en @ 1 kHz	I_b max
Quad					
ADTL084A	8 to 36	5 mV	2.5 mA	15 nV/sqrt(Hz)	100 pA
AD8694	2.7 to 6	2 mV	1.05 mA	12 nV/sqrt(Hz)	1 pA
AD8684	4.5 to 18	1 mV	250 µA	30 nV/sqrt(Hz)	100 pA
AD8648	2.7 to 6	2.5 mV	1.8 mA	8 nV/sqrt(Hz)	1 pA
AD8664	5 to 16	100 µV	2 mA	12 nV/sqrt(Hz)	1 pA
Dual					
OP291	2.7 to 12	700 µV	420 µA	35 nV/sqrt(Hz)	65 nA
AD8666	5 to 16	2.5 mV	2 mA	12 nV/sqrt(Hz)	1 pA

Product Link

www.analog.com/AD8666



Amplifiers: Variable Gain Amplifier

AD8334 Quad VGA with Ultralow Noise Preamplifier and Programmable RIN

Key Features

- Ultralow noise preamplifier
  - Voltage noise = 0.74 nV/√Hz
  - Current noise = 2.5 pA/√Hz
- -3 dB bandwidth: 100 MHz
- SNR = 101 dB (5 MHz bandwidth)
- Low power: 145 mW/channel
- Wide gain range with programmable post amp
  - -4.5 dB to +43.5 dB
  - +7.5 dB to +55.5 dB

Benefits

- Low output-referred noise: 48 nV/√Hz typical
- Active input impedance matching
- Optimized for 10-/12-bit ADCs
- Selectable output clamping level
- Single +5 V supply operation

Key Applications

- Ultrasound and sonar time-gain controls
- High performance AGC systems
- I/Q signal processing
- High speed, dual ADC drivers

Cost

$14.49 per unit in 1k quantity

Package Options

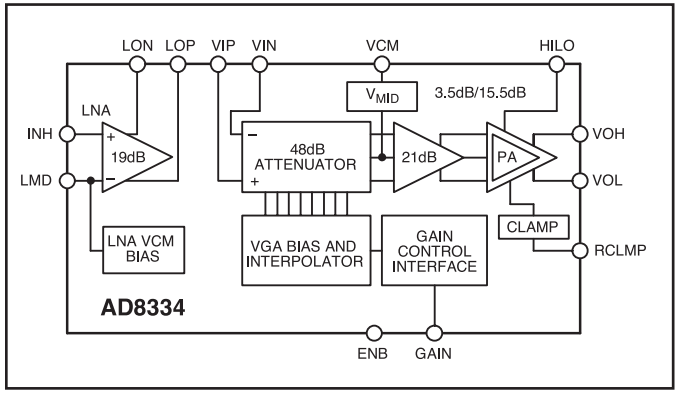
- 64-lead LFCSP (9mm x 9mm)

Related Devices

- AD9222, AD9228 12-bit ADCs
- AD9212, AD9219 10-bit ADCs

Product Link

www.analog.com/AD8334



Modulators/Demodulators

AD8333 DC to 50 MHz, Dual I/Q Demodulator and Phase Shifter

Key Features

- Dual integrated I/Q demodulator
- 16 phase select on each output (22.5° per step)
- Quadrature demodulation accuracy
- Phase accuracy: ±0.1°
- Amplitude balance: ±0.05 dB bandwidth
- 4 LO: 100 kHz to 200 MHz
- RF: DC to 50 MHz
- Baseband: determined by external filtering
- Output dynamic range: 161 dB/Hz
- LO drive > 0 dBm (50 Ω); 4 LO > 1 MHz
- Supply: ±5 V
- Power consumption: 190 mW/channel (380 mW total) power down

Benefits

- Compared to existing multi-chip solutions AD8333
  - simplifies design, reduces component count
  - 80% board area reduction per channel
  - equals or exceeds the dynamic range of existing solutions.

Key Applications

- Medical imaging (CW ultrasound beamforming)
- Phased array systems
- Radar
- Adaptive antennas
- Communication receivers

Cost

$8.95 per unit in 1k quantity

Package Options

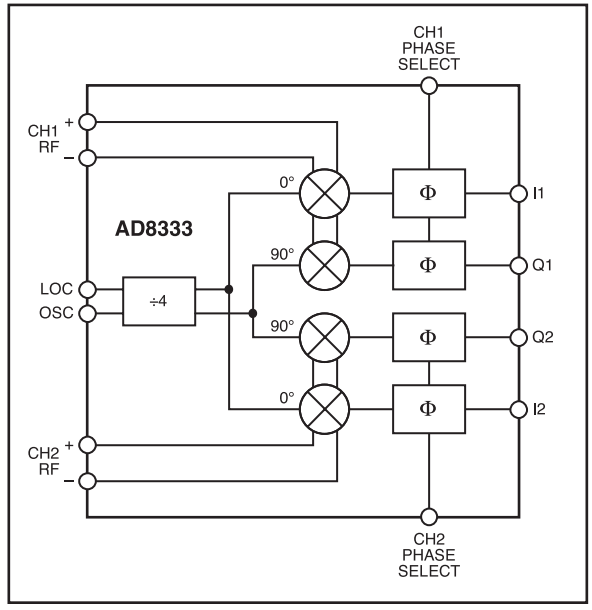
- 32-pin LFCSP (5 mm x 5 mm)

Related Devices

- AD8332/4/5 variable gain amplifier (VGA)
- AD9510 clock IC
- AD8021 high-speed amplifier
- AD8016 line drive
- AD7665, AD7679, AD7686, AD7693 PulSAR® ADCs

Product Link

www.analog.com/AD8333



Amplifiers: JFET Input, Instrumentation Amplifier

AD8220 Rail-to-Rail Output JFET Input Instrumentation Amplifier

Key Features

- Low input currents
  - 10 pA maximum input bias current (B grade)
  - 0.6 pA maximum input offset current (B grade)
- High CMRR
  - 100 dB CMRR (minimum), G = 10 (B grade)
  - 80 dB CMRR (minimum) to 5 kHz, G = 1 (B grade)
- Excellent ac specifications and low power
  - 1.5 MHz bandwidth (G = 1)
  - 14 nV/√Hz input noise (1 kHz)
  - 2 V/µs slew rate
  - 750 µA quiescent supply current (maximum)
- 4.5 V to 36 V single supply
- ±2.25 V to ±18 V dual supply
- Gain set with single resistor (G = 1 to 1000)

Benefits

- Compared to TI/BB INA121
  - Package: ½ Size of MSOP
  - 25 dB more CMRR @ 5 kHz
  - 5 µV/°C V_{os} drift
  - 2x input range
- Rail-to-rail output
- Input voltage range to below negative supply rail
- 4 kV ESD protection

Key Applications

- Medical instrumentation
- Precision data acquisition
- Transducer interface

Cost

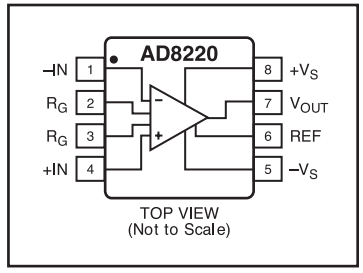
$2.29 per unit in 1k quantity (A-grade)
$3.49 per unit in 1k quantity (B-grade)

Package Options

- 8-lead MSOP

Product Link

www.analog.com/AD8220



Amplifiers: Audio

SSM2211 Low Distortion, 1.5 W Audio Power Amplifier

Key Features

- 1.5 W output
- Differential (BTL²) output
- Single-supply operation: 2.7 V to 5.5 V
- Functions down to 1.75 V
- Wide bandwidth: 4 MHz
- Highly stable phase margin: >80 degrees
- Low distortion: 0.2% THD + N @ 1 W output
- Excellent power supply rejection

Benefits

- High performance audio amplifier delivers 1.5 W rms into a bridge connected 8 Ω speaker load
- Superior performance delivered at higher power or lower speaker load impedance than competitive units

Key Applications

- Personal computers
- Personal wireless communicators
- Hands-free telephones and transceivers
- Speaker phones
- Intercom systems
- Musical toys and games
- Other low voltage audio systems requiring 1 W output power

Cost

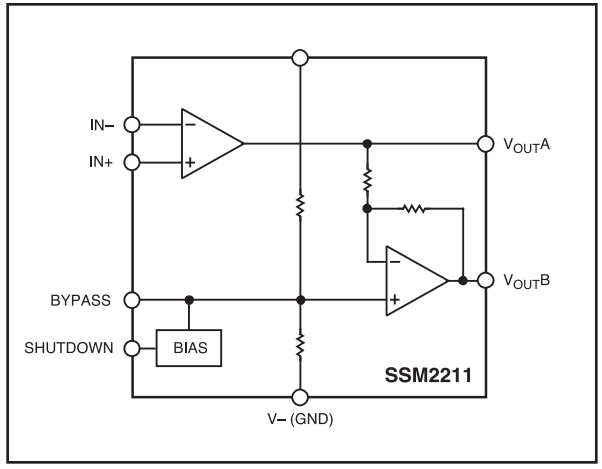
$0.40 per unit in 1k quantity

Package Options

- 8-lead SOIC
- 8-lead LFCSP

Product Link

www.analog.com/SSM2211



Processors: SHARC

ADSP-21375 High-Performance 32-Bit Floating-Point SHARC Processor

Key Features

- 266 MHz SIMD SHARC core, capable of 1596 MFLOPS peak performance
- 0.5 Mbits on-chip SRAM
- 24 zero-overhead DMA channels
- Digital Applications Interface (DAI) enabling user-definable access to peripherals
- 4 serial ports (SPORTs) supporting I2S, left-justified sample pair, and TDM modes
- 2 SPI-compatible ports supporting master and slave modes
- 1 UART
- 1 TWI
- 2 full-featured timers

Benefits

- SHARC processor supports 32-/40-bit floating-point operations, featuring ADI's Super Harvard Architecture, with a large on-chip SRAM, and an independent DMA engine with multiple internal busses to eliminate I/O bottlenecks
- It is third-generation SHARC Processors, enabling “scalable performance” - customers gain the ability to spread development costs across multiple products based on a single platform design - reducing development time and maximizing return on investment.

Key Applications

- Medical
- Test, measurement and instrumentation
- Industrial control

Cost

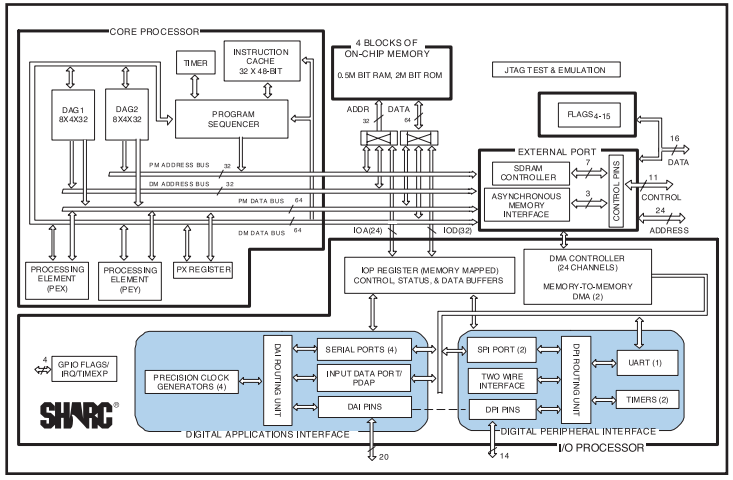
$9.25 per unit in 1k quantity

Package Options

- 208-lead MQFP

Product Link

www.analog.com/processors



VisualDSP++ for SHARC Processors

Easy-to-use integrated software development and debugging environment (IDDE). Efficiently manage projects from start to finish from within a single interface. To take a test drive, visit *www.analog.com/aie/testdrive*

Medical Applications Product Selection Table

Amplifiers				
Product	**Bandwidth**	**Supply**	**Package**	**Features**
AD8666	4 MHz	5 V to 16 V	SOIC, SOP	low cost, rail-to-rail output op amp with low bias current
AD8334	100 MHz	5 V	LFCSP	quad VGA with low noise pre-amp and programmable R_{IN}
AD8220	800 kHz	5 V to 36 V	MSOP	rail-to-rail output instrumentation amp with JFET input
SSM2211	4 MHz	1.75 V to 5.5 V	SOIC, LFCSP	low distortion, 1.5 W audio power amplifier

Data Converters						
Product	**Type**	**Resolution**	**Interface**	**Supply**	**Package**	**Features**
AD7266	ADC	12 bits	SPI	2.7 V to 5.25 V	CSP, QFP	2 MSPS dual ADC with on-chip reference
AD7685	ADC	16 bits	SPI	2.3 V to 5.5 V	CSP, MSOP	250 kSPS low power ADC with no pipeline delay
AD5259	Digi-Pot	8 bits	I2C	2.7 V to 5.5 V		256 position digital potentiometer with nonvolatile memory

Additional Devices in this Promotion			
Product	**Function**	**Supply**	**Features**
AD7142	Capacitance-to-Digital Converter	2.6 V to 3.6 V	integrated system for capacitive input devices, includes environmental calibration
ADuC7026	Analog Microcontroller	2.7 V to 3.6 V	ARM7 architecture microcontroller with 12-bit ADCs, 12-bit DACs, and PWM generator
AD8333	I/Q Demodulator	±5 V	dual I/Q demodulator for DC to 50 MHz signals in LFCSP package
ADSP-21375	Processor	1.2 V	32-bit floating-point SHARC processor with 266 MHz clock and 4 serial ports

Ask your distributor sales representative to provide information on these complementary "analog is everywhere" promotions:

Industrial Applications

- AD7400: isolated sigma-delta modulator
- ADuM1300: *i*Coupler® triple-channel digital isolator
- AD2S1200: 12-bit R/D converter with reference oscillator
- AD5754R: 16-bit, serial input, uniploar/biploar voltage output DAC
- ADR02: ultra compact precision +5.0 V reference
- AD8655: low noise, precision CMOS amplifier
- AD8310: fast response, DC - 440 MHz, voltage out, 90 dB logarithmic amplifier
- AD8137: low cost, low power 12-bit differential ADC driver
- AD8603: precision single micropower rail-to-rail input/output low noise CMOS operational amplifier
- AD7942: 14-bit, 250 kSPS PulSAR® ADC
- ADuC7128: precision analog microcontroller

Security and Surveillance Applications

- AD5233: nonvolatile, quad, 64-position digital potentiometer
- AD8668: 16 V, 4 MHz rail-to-rail output amplifier
- AD7276: 3 MSPS,12-bit ADC
- ADR125: precision micropower LDO voltage reference
- ADG721: CMOS Low Voltage 4 Ω Dual SPST Switch
- ADA4851-1: low cost, high-speed rail-to-rail output operational amplifier
- AD8131: low cost, high speed differential driver
- AD8130: low cost 270 MHz differential receiver amplifier
- AD8113: audio/video 60 MHz 16 x 16 crosspoint switch
- ADV212: JPEG 2000 video codec
- ADSP-BF548: high performance convergent Blackfin® processor

Analog Devices Line Card

Amplifiers and Comparators
Audio Amplifiers
Buffer Amplifiers
Comparators
Current Sense Amplifiers
Differential Amplifiers
Gain Blocks
Instrumentation Amplifiers
Isolation Amplifiers
Log Amps/Detectors
Operational Amplifiers (Op Amps)
Variable Gain Amplifiers

Analog-to-Digital Converters
A/D Converters
Audio A/D Converters
Capacitance-to-Digital Converters
Energy Measurement
Isolated A/D Converters
Synchro/Resolver-to-Digital Converters
Temperature-to-Digital Converters
Touchscreen Controllers
Video Decoders
Voltage-to-Frequency Converters

Digital-to-Analog Converters
D/A Converters
Audio D/A Converters
Digital Potentiometers
Video Encoders

Embedded Processing and DSP
Blackfin® Processors
TigerSHARC® Processors
SHARC® Processors
ADSP-21xx Processors
Development Tools

MEMS and Sensors
*i*MEMS® Accelerometers
*i*MEMS Gyroscopes
Analog/Digital Temperature Sensors

RF/IF Components
Direct Digital Synthesis (DDS)
Gain Blocks
Log Amps/Detectors
Mixers/Multipliers
Modulators/Demodulators
PLL Synthesizers/VCOs
RF/IF Transceivers
RF Switches
RMS Detectors
Rx/Tx Subsystems
Short Range Transceivers
DDS Modulators
Digital Up-/Downconverters

Switches/Multiplexers
Analog Crosspoint Switches
Analog Switches
Digital Crosspoint Switches
Digital Switches
Multiplexers (Muxes)
RF Switches

Analog Microcontrollers

Interface
Isolators
Level Translators
RS-232
RS-485
Transceivers

Power and Thermal Management
Analog/Digital Temperature Sensors
Battery Chargers
Charge Pumps
Fan Controllers
Hot Swap Controllers
LED Drivers
Linear Regulators
MOSFET Drivers
Multifunctional Power ICs
Power Supply Controllers
Power Supply Sequencers
Supervisory
Switching Controllers
Switching Regulators
System Monitoring Products
Temperature Setpoint Controllers

References
Voltage References

Clock and Timing
Clock Generation and Distribution
PLL Synthesizers/VCOs
Clock and Data Recovery/Retiming

Wireless Products
Baseband Processing
Cellular Terminal Chipsets
DDS Modulators
Digital Up-/Downconverters

Other Linear
Analog Multipliers/Dividers
Hall Effect Sensors
LVDT Sensor Amplifiers
Matched Transistors
RMS-to-DC Converters
Sample/Track-and-Hold Amplifiers

Audio/Video Products
Audio A/D Converters
Audio Amplifiers
Audio Codecs
Audio D/A Converters
Audio Signal Processors
Camera/Camcorder Analog Front Ends
Display Interfaces
Display Driver Electronics
Lens Driver Components
Sample Rate Converters
Video Codecs
Video Compression
Video Encoders
Video Decoders
Video Filters

Broadband Products
Broadband Amplifiers
Broadband Codecs
DSL/ADSL Chipsets
CATV Amps/Splitters
Clock and Data Recovery/Retiming
Digital Crosspoint Switches

Fiber/Optic
Clock and Data Recovery/Retiming
Laser Drivers
Log/Limiting Amplifiers
Transimpedance Amplfiers

Other
Automatic Test Equipment
IOS Subsystems
Military/Aerospace
Modems
Multichip

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